THE TECH

DAILY

VOL. XXIX. NO. 69. BOSTON, MASS., SATURDAY, DECEMBER 18, 1909 PRICE FIVE CENTS

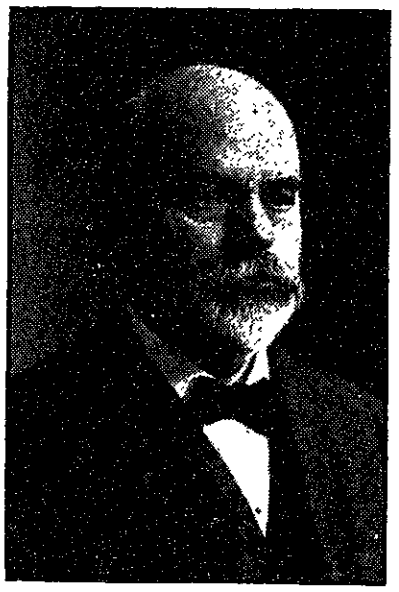
MARINE ENGINEERING

Option in Fourth Year by Head of Naval Arch. Dept.

By. PROF. C. H. PEABODY.

The option of marine engineering was started in 1885, with the intention of giving an opportunity for the study of the contribution and operation of large steam engines, especially as applied to the propulsion of ships. As stationary engines approach the size of marine engines there is a tendency for them to approach the type of construction that has become standard for them; and in any case the methods for determining the proportion and dimension of engines of all classes are substantially the same.

Custom assigns the construction of the propeller to the marine engineer, and he therefore needs a good conception of its operation and the conditions that lead to good efficiency. The option, therefore, takes up the discussion of the resistance and propulsion of ships so far as is necessary for that purpose. This instruction is accompanied with the design of a propeller, and the computation



PROF. CECIL H. PEABODY.

of the results of a progressive speed trial.

The design of a marine engine is so intricate that it cannot conveniently be worked out directly, but must be made to depend on the intelligent adaptation of conditions that have been formed to give good results in engines already built. These conditions can be expressed in certain simple approximate methods which can be controlled by the determination of factors that can be varied to suit different conditions. When the factors are well determined a new engine can be designed with rapidity and a good degree of certainty. The methods, in fact, are of the order of interpolation or extrapolation of results already obtained. After the proportions and sizes of the various members of the engine have been assigned, the complete design may be undertaken to ascertain whether the engine is well adapted to its service.

The final design includes (1) the construction of probable indicator diagrams, and the determination from them of the forces exerted by steam pressure on the members of the engine; (2) the design of the moving parts of the engine and the computation of their weights, so that the dynamic forces due to their motion can be determined; (3) the determination of the resultants of the static and dynamic forces for a sufficient number of crank angles and the relation of the conditions that give the maximum stresses in the various members of

(Continued on page 20.)

HISTORY AMD SUMMARY OF MECHANICAL ENGINEERING

The Growth of the Course in Curriculum and Apparatus. Iimportance of Investigations Conducted.

By PROF. GAETANO LANZA.

In most industrial pursuits there are certain processes to be carried out and attention must be given to devising and preparing the means of doing this effectively and cheaply, to the best machines to be used for all the steps, a consideration of their efficiency, durability, first cost, the expenses necessary for their attendance, also for their maintenance, repairs, etc., to the construction and arrangement of the power plant whether steam or water is used, to the system of transmission, the design and construction of buildings adapted for the work, including foundations, water supply, drainage, heating and ventilation, light, lighting, fire protection, and a large number of matters of a similar character all of which are engineering problems. With such questions the mechanical engineer is concerned, and his duties consist in solving problems of this kind as they arise. In order that he may be successful he needs: first, a knowledge of scientific principles and of the experience of the past, and second, his own experience. The latter cannot be imparted in a school, but each man must acquire it for himself subsequently.

Hence the function of the school is to give to the student knowledge of and power to apply scientific principles, so that he may be able to make use of those which bear upon his particular work. Such a purpose is clearly outlined in "A Plan for a Polytechnic School in Boston," by Prof. William B. Rogers in 1846. (See Life and Letters of Wm. B. Rogers, pps. 420, et seq.) The first catalogue of the Institute was issued in 1865 and the first course in the list, then called Course I, was that in Mechanical Engineering. While no separate engineering laboratory was proposed at that time, there was proposed a laboratory of Physics and Mechanics. In the year 1873-74 was installed a 20 H. P. steam engine with a condenser, weighing tanks, and the apparatus necessary for tests which, together with the boilers of the Institute, formed the first plant established in any school adapted to the making of engine and boiler tests. It was rendered possible by the fact that Mr. George B. Dixwell was willing to bear a part of the expense in order that an experimental study in which he was interested might be made upon cylinder condensation.

In the year 1881-82 a testing machine of fifty thousand pounds capacity was installed in the laboratory of Applied Mechanics, so arranged as to render possible the testing of full-sized beams up to twenty-five feet span, and immediate use was made of the machine to test the transverse strength of full-sized timbers, an investigation that has been pursued ever since and which has served to establish constants for use in practice that are quoted as authority in many sets of building laws, engineers' hand-books, and elsewhere. Moreover, the plan of the work now being pursued by the Division of Forestry of the Department of Agriculture of the United States has been largely based upon the methods used and the results obtained at the Institute.

In the year 1883-84 the course was re-organized and a development of the laboratory was started which has caused it to expand from the small plant installed in 1873-74 to its present dimensions and equipment. It now occupies 23,500 square feet of floor space and contains a great amount and variety of machinery adapted for the work, an Emery Testing Machine of three hundred thousand pounds capacity, and a Steam Turbine of five hundred Kilowatt capacity, besides many other large machines. The course of instruction has been continually developed in the attempt to keep it up to the needs of the times.

The two fundamental sciences upon which the principles of engineering mainly depend are Mathematics and Physics. The student should acquire not only a thorough knowledge of those portions of pure mathematics that he needs in order to make the calculations required in his work but he should also have the power to draw the necessary conclusions which concern the subjects with which he must deal in his profession, and this power is all-important, for if he is to be fit to assume responsibility at some time, he ought not to allow himself to use any formula without knowing how it was obtained and what are the assumptions made in deducing it, as well as the experimental basis upon which rest the constants which he uses. Moreover, as time goes on, important work is less and less trusted to "rule of thumb" engineers.

A course in Physics affords the suitable preparation for a proper understanding of the scientific principles of most of the work with which the student will come in contact. Therefore he should have a thorough course in general Physics and, in addition, he needs a certain amount of work in the Physical Laboratory, since it teaches him how to make careful and accurate experiments.

Turning next to the subject of drawing, including descriptive geometry,

PROF. GAETANO LANZA.

two of the objects to be accomplished are first, the power of execution, and second, the power to read and to express ideas by means of drawings; in other words he needs to know the language of drawing, for in his future work it is a language which he will constantly use. Of course the student should be taught to make all the detailed drawings needed in the shop and also the necessary assembly drawings, and to make them in such a way that they can be practically used, i. e., according to a good shop system of dimensioning. He also needs the power to use his drawing in the solution of problems whether of Mechanism or of Machine design, or other subjects.

Some brief remarks will next be made in regard to that portion of the professional work which is given in the classroom. The subjects are treated thoroughly, comprehensively, and in proper sequence, both the theory and the results of experiments made under the conditions of practice being presented.

(Continued on page 14.)

STEAM ENGINEERING

Detailed Description of the Course Given to Third-Year Students.

By PROF. E. F. MILLER.

The course in steam engineering as given today, differs considerably from the course given ten or fifteen years ago. This is due partly to the changes which have taken place in the methods of generating power, partly to the advance made in the design of steam machinery, and partly to the fact that a great deal of new work must now be given each year in order to keep pace with the advances made along steam engineering lines.

The course has been increased by about fifteen lectures and since the study of Valve Gears, which was formerly given under the head of "Steam Engineering," has been transferred to the second year where it is taken now as a part of the study of Mechanism, there have become available some

PROF. EDWARD F. MILLER.

twelve hours more, which have been used to advantage in new work in steam engineering. Before taking up the theoretical work of the course in steam engineering the students are given a series of cuts illustrating many of the auxiliaries used in connection with modern power stations, different systems of pumping by means of compressed air, different types of pumps, and various types of condensers, dry vacuum pumps, circulating pumps, together with general descriptions of the different types of steam turbines and steam engines. They are also given some work on cooling towers, coal handling, and coal handling machinery, and the construction of coal pockets.

Following this general descriptive course comes the theoretical work in Thermodynamics. This includes the study of perfect gases, saturated steam, superheated steam, economies of engines, turbines, design of turbine nozzles, calorimetry, compressed air, air compressors, refrigerating machines, and

(Continued from page 11.)

INDEX.

Concrete Engineering 22
Current Events 14
Drawing 15
Engineering Laboratories 19
Graduates of Course 2 12
Letters from Graduates 20
Machine Design 21
Marine Option 11
Mechanical Engineering 11
Mechanics Arts 21
Plans 16, 17, 18
Steam Engineering 11
Turbine Option 20
Ventilation Option 15

GRADUATES OF COURSE II

What They are Doing and What They Studied.

By PROF. J. C. RILEY.

The average man coming to the Institute to study engineering knows very little of the different branches of that profession. His choice of a course is usually governed by the wishes of his parents and by the more or less incorrect notions he gets from the new older students and teachers with whom he becomes personally acquainted during his first year. From that time on, until he graduates, his time is filled in rounding out his liberal education and in studying the fundamental sciences with their application to a few selected examples of engineering. He has little opportunity of meeting men actively engaged in engineering and knows but little of the work they do.

After graduation he must usually begin earning money at once. There is no difficulty in his obtaining a position, but the number of situations available is not so great that he can afford to let a reasonably good opportunity slip by, so very often he takes the first chance that comes, and begins work in a business about which perhaps he knew almost nothing a week previously. During his first five years out of school he may change his position several times. Very likely he makes a radical change in the nature of his occupation, sometimes from dislike for the old vocation, sometimes through a distinct preference for the new, but oftener through events over which he has little control. After about five years, however, he has generally located permanently, and thereafter his changes are mainly advances or promotions to positions of greater responsibility.

Let us see what are the professions of those graduates of Course II who have passed through this period of change and settled down to their life work. The following table was compiled from the Register of Graduates, published in 1908, and includes 653 men who graduated before 1905.

GRADUATES OF THE COURSE IN MECHANICAL ENGINEERING.

		Per cent.
1.	Mechanical engineers in the employ of corporations or private firms	32.1
2.	Managers, superintendents or proprietors of engineering works or establishments	7.2
3.	Managers, superintendents or proprietors of manufacturing establishments	13.6
4.	Secretaries, treasurers, financial or cost managers and "production engineers"	7.0
5.	Teachers	7.5
6.	Designers and draftsmen	5.2
7.	Lawyers and patent examiners	2.8
8.	Consulting engineers	2.9
9.	Insurance engineers and inspectors	3.4
10.	Civil and electrical engineers, contractors and architects	3.4
11.	Sales or purchasing agents for engineering firms	3.4
12.	Business men and others whose work is quite apart from engineering	5.5
13.	Not known, or not classified	6.0
		100.0

It is difficult to estimate a man's duties from the short statements of his occupation which he sends for publication in the Register. Nevertheless, let us take the above list as fairly correct, and consider the probable qualification and daily work of the men.

The first and largest group, about a third of all Course II's graduates, includes men under salary, who have charge of design, construction, maintenance and operation of many different kinds of mechanical plants, machinery, and processes. Probably more than half have administrative or executive duties too, but the criterion which places them in this group is that in their daily work they must apply a knowledge of scientific principles and practical engineering. They originate, investigate, or develop the ideas on which successful completion of the firm's engineering work depends. They differ from the men of group 2, in that usually they are subordinate, and as such are responsible for details from which managers are often free. The work of these men as a class differs greatly, and so may the work of each man, from day to day. Perhaps today the engineer may be comparing the cost and general desirability of several plans for enlarging the plant without interfering with the product; tomorrow he is sent to conduct the acceptance test of an engine which the firm has erected; and next week he may be called suddenly, to say what immediate steps shall be taken to repair a breakdown, and then to design a new part to replace the old so that it cannot break again. His duties are varied and call for sound technical training, good judgment, and all the ingenuity and general experience he possesses.

Group II includes older men of longer experience, who have advanced to the management of engineering work, or whose fortunes have enabled them to go into engineering for themselves. These men are superintendents of motive power, managers and owners of machine shops, pump and engine works, and the like. In their present position, many of them have forgotten most of the scientific, and a good deal of the general information they once possessed. For questions of detail, in all but the most important matters, they accept the figures and designs of their assistants of Group I, but for management of the business and its employees, and for decision of engineering questions of great importance, their wide experience and business training makes them really of greater value than the engineers. Problems involving material things and the laws of science are often difficult; but problems involving the human element too, are more difficult still. The engineer who studies and tests the turbines built by his firm until he finds wherein and why they are less efficient than those of a competitor, and then re-designs and perfects his own until the results are satisfactory, is a valuable man to his firm; but the manager or superintendent with sound judgment and good executive ability, who shapes the general policy of his firm or his department, who makes prices, directs the work of his subordinates and perhaps by a just and tactful management avoids or settles a strike, is worth more than an engineer, and usually he gets more.

Group III includes men to whom engineering training is not so valuable as to the previous groups. The work which they control is mechanical, but the product is usually some small article or some material manufactured by wholesale, and each day's work is a repetition of the day before except in so far as the product or process can be improved. A Tech man with one of the large hardware factories recently stated that his firm would not accept orders for hinges of a special pattern in lots smaller than a hundred thousand dozen. Improvements lessening the cost of production of even the cheapest articles, made in such large numbers, are of great importance, and worthy the efforts of the best mechanically trained men, but such work usually falls to the inventor or the designer rather than to the technically educated engineer. Technology's Course II men are well represented in the management of firms in the United States, Canada, and Europe, engaged in the manufacture

(Continued on page 22.)

CHAS. T. MAIN
MILL ENGINEER AND ARCHITECT.
Room 911, 45 Milk Street,
BOSTON, MASS.

Alexander Willett Moseley '91
DEPARTMENT OF ENGINEERING
LEWIS INSTITUTE, CHICAGO.

Harvey S. Chase & Company
AUDITORS
and
EXPERT EXAMINERS OF ACCOUNTS

Especial experience in audits of Manufacturing Accounts; of Municipal Accounts; of Trust and Probate Accounts; and in investigations of corporations or firms for creditors, assignees and banking institutions.

REFERENCES.

To officers of Banks, Corporations, etc. Terms: Annual Audits are undertaken for stipulated sums, Investigations are made upon contract or at rates by the hour or day. Competent assistant auditors, duly supervised by us, will undertake minor work at lower rates. All audits confided to us, whether of greater or lesser importance will be done accurately, faithfully and promptly.

84 STATE STREET, BOSTON.

Telephone 3660 Main

FRANK G. McCANN '96
500 PARK AVENUE, NEW YORK, N. Y.
Member Amer. Soc. Heating & Ventilating Engineers; Member Assoc. Board of Education Designing Engineers; Chief of Heating & Ventilating Division, Board of Education of City of New York.
Consulting Mechanical Engineer.
Specialty—School House Ventilation.
Plans and Specifications checked and revised.

COMPLIMENTS OF
Wm. C. Richardson '91

FOR OVER TWENTY-FIVE YEARS

We have served the wants of Mechanical Engineers in HEAT and COLD insulation with the best materials and workmanship obtainable. Our name is a standard in this line of work. We specialize in 85% MAGNESIA and NONPAREIL CORK insulation.

NIGHTINGALE & CHILDS CO.
205 CONGRESS ST., BOSTON, MASS.
H. N. DAWES, M. I. T. '93, VICE-PRESIDENT

The Production of

UNIVERSAL

PORTLAND CEMENT

Year	Output of UNIVERSAL Portland Cement bbls.	Percentage of total American output of Portland Cement
1900	32,000	0.38%
1901	164,000	1.29%
1902	319,000	1.85%
1903	463,000	2.08%
1904	473,000	1.78%
1905	1,735,000	4.92%
1906	2,076,000	4.55%
1907	2,129,000	4.36%
1908	4,535,000	8.80%
1909	*6,000,000	

*Estimated

Additional capacity now under construction will give us an output of 8,000,000 barrels for 1910.

UNIVERSAL

Portland Cement Company

CHICAGO :: PITTSBURG

EDWARD M. HAGAR, M. I. T. '93, President

THE TECH

Published daily except Sunday during the college year by students of the Massachusetts Institute of Technology.

Entered as second class matter Sept. 29, 1909, at the post office at Boston, Mass., under the Act of Congress of March 3, 1879.

General Manager,
R. H. Ranger 1911

News Board.
D. P. Gaillard 1911 ....Editor-in-Chief
A. L. Fabens 1910 ....Institute Editor
J. I. Murray 1912 .....Athletic Editor
G. M. Keith 1912 ....Exchange Editor
N. McL. Sage 1912 .....Society Editor

Business Board.
N. DeForest 1911.....Business Manager
D. N. Frazier 1911, Circulation Manager
H. Merrill 1912 ...Advertising Manager

SPECIAL ISSUE.
J. W. Nickerson 1909
A. L. Fabens 1910
W. J. Orchard 1910 .....Assoc. Editor

All communications regarding advertisements should be addressed to the Business Manager. Regarding subscriptions address the Circulation Manager.

Subscriptions within the Boston Postal District and outside of United States must be accompanied by postage at the rate of one cent for each copy.

Subscription $1.50 per year in advance
Single Copies 1 Cent.

Printed by Puritan Linotype, Boston

BOSTON, MASS., DECEMBER 18, 1909.

The Department of Mechanical Engineering is presented in this issue by many articles. The course is covered by a general article, and by numerous others presenting the more important courses of the later years. Of much interest to the senior class, will be the record of what former graduates are doing.

The Tech wishes to express its gratitude for the contributions of professors and graduates.

The Tech also regrets that at the last minute the space limit excluded an article on "Mechanical Engineering at Other Institutions," by Mr. Walter Humphreys.

MECHANICAL ENGINEERING.

(Continued from page 11.)

A very large number of applications to engineering work are introduced, thus acquainting the student with current practice, with the problems that arise in the pursuit of his profession, and with the manner of applying to their solution not only the theory, but also the results of experiments, and this is considered a very important part of the instruction.

Mechanism

Which is that portion of kinematics which finds application in engineering. This course includes the design of gear-teeth, and also a study of valve gears, which latter is fundamental to the understanding of the action of the steam engine.

Applied Mechanics.

This course touches vitally engineering work at almost every point. It comprises a general and mathematical discussion of the action of forces upon bodies, whether at rest or in motion, including stresses in all sorts of structures and parts of machinery and also a full treatment of the strength and elasticity of materials, including pieces subject to tensile, compressive, shearing, torsional, and compound stresses. It also treats of the results of experiments, especially those made under the conditions of practice. Any attempt to enumerate the applications presented in this course would require far more space than can be devoted to it in this article.

Thermodynamics.—Steam and Gas Engineering.

Inasmuch as Thermodynamics is the mechanical theory of heat, and as steam is still the principal source of power, and without it most all of our works would have to shut down, the importance of such a course is self-evident. Moreover, the practical applications in this case and the problems that arise in the use of heat as a source of power, include the consideration of an enormous quantity of machinery, as steam engines, steam turbines, gas engines, gas producer plants, oil engines, boilers, condensers, and a very large amount of other apparatus.

Hydraulics and Hydraulic Motors.

In whatever special line the prospective engineer is subsequently engaged, he may have to establish pumping stations for water supply or for drainage, or the works necessary for a power plant, or a dock or wharf if his works are on the water's edge.

Electricity.

Inasmuch as electricity has come to play such an extensive part in mechanical engineering work it is necessary that the student should have as much familiarity with its principles as time will allow. As examples of these applica-

PROF. CHARLES E. FULLER.

tions we have especially, electric transmission, electric cranes, electric lighting, and electric railroads.

Machine Design.

This course is of the greatest importance to the student and especially that portion which deals with the details of machines and brings to bear upon their design, the principles of Applied Mechanics, Thermodynamics, etc.

Mechanic Arts.

A course in the mechanic arts is given, not for the purpose of making the student a finished workman, but so that he may be familiar, through his own experience, with the way in which things are made and that he may thus be able to avoid designs which are either impossible or unduly expensive to construct.

The remaining subjects in the Course will not be commented upon, in order to avoid making this article too long.

PROF. WILLIAM A. JOHNSTON.

In addition to the professional studies a considerable amount of time is devoted to literary, historical, and economic studies, with the view of giving the student a greater breadth, and to aid in making him a well-rounded man.

There is also another matter that is of the greatest importance to the prospective engineer, and that is, that he should be taught to perform original investigations inasmuch as the ability to conduct them is much needed by the engineer in the practice of his profession, and with this purpose in view, a thesis is required of the student before he can receive his degree, this thesis to consist of an investigation.

The investigations made in the laboratory, partly in connection with the

(Continued on page 19.)

GENERAL NOTICES.

FIRST YEAR.

Entrance Condition Examinations.

First-year students are expected to take at the end of the present term all entrance examinations in which they have not already clear records, with the following exceptions:

1. Students having conditions in entrance History and entrance Physics. No examination will be held in entrance History and entrance Physics at the semi-annual examination period.

2. Special students taking no work dependent on entrance subjects in which they have not clear records. Such students, if they desire to become regular, may take remaining examinations in June or September.

3. Students who are now making up entrance French and German by taking the elementary courses, although they are privileged to take these examinations.

4. Students entitled to excuse from particular entrance conditions on the basis of good term work. This applies to conditions in entrance Algebra, English, French, German, and Plane Geometry and students will be notified if excuse can be given.

For the Faculty Committee on Entrance Examinations,
WALTER HUMPHREYS,
Registrar.

December 14, 1909.

FIRST YEAR.

Conference hours for students who wish to confer with Heads of Departments in regard to the Choice of Course.

COURSE I—Prof. Spofford will meet students on Tuesday, Dec. 21st, from 1 to 1:30 in 42 Eng. A.

COURSE VI—Prof. Jackson will meet students on Monday, Dec. 20th, at 1 P. M. in 6 Lowell.

COURSE VII—Prof. Sedgwick will meet students Tuesday, Dec. 14th, at 4 P. M.; Wednesday, Thursday, and Saturday, Dec. 15th, 16th and 18th at 12 o'clock, in 27 Pierce.

COURSE VIII—Prof. Cross will meet students any day but Saturday at 12:05 in 11 Walker.

COURSE XI—Prof. Porter will meet students on Wednesday, Dec. 22nd, from 1 to 2 in 46 Eng. A.

DYNAMO ELECTRIC MACHINERY (661)

The problems recently assigned will be due on Dec. 21.

HARRISON W. SMITH.

MILITARY SCIENCE.

The Drill hour, on Mondays and Fridays, on and after January 3rd will be changed from three to two o'clock .

WALTER HUMPHREYS,
Registrar.

ELECTRICAL ENGINEERING.

There will be a final examination in Elecrical Engineering (683) for Course II men, on Saturday afternoon, December 18th, from 2 to 4, in Room 30, Engineering Building A.

WALTER HUMPHREYS,
Registrar.

TECH SHOW

All lyrics to be handed in at Cage for K. Greenleaf by 4 P. M., Dec. 18. Music writers to meet Mgr. Greenleaf in Show office at 4. P. M., Tuesday, Dec. 21.

1910

1910. Only those Seniors who have paid their class dues up-to-date, will be allowed to vote. Names of those who have not paid will be posted up in the Union. Dues may be paid to W. O'Hearn, I and XI; L. O. French II; R. Goodwin, III; H. S. Clevendon, IV; E. M. Potter, VI; D. Clapp, X; M. P. Anderson, XIII and Luther Davis, XIV.

CALENDAR.

Saturday, December 18.
2:30 Hockey Practice.
Monday, December 20.
3:30 Hockey Practice.
4:00 Gym Team Practice.
Tuesday, December 21.
8:00 Gym Meet at Gym.
Wednesday, December 22.
8:00 Mech. Eng. Society at Union.

ANNUAL WINTER CONCERT VERY ENJOYABLE

About Two Hundred Couples Present in Copley Hall Last Evening.

When at two o'clock this morning, with the last strains of music, the Winter Concert became a thing of the past, it was the unanimous opinion of all present that the evening had been a most enjoyable one, and that the management of the Musical Clubs had established more firmly than ever their claims to the enthusiastic support of the undergraduates.

The Hall itself was most attractively decorated, the walls being completely covered with Oriental Tapestries and rugs, and with large antique urns and vases suspended from the ceiling.

The program, though short, was rendered in a very capable manner and the audience by their applause called for repeated encores. The opening number was "'Tis Morn," by Giebel, which was sung by the Glee Club, and was followed, as an encore, by "My Pipe Dream," by Packard, '07, from Tech Show, 1907.

The Mandolin Club in the second number made their first appearance, playing the "Pied Piper Selections," J. S. Martin adding greatly to the enjoyment of the number by his accompaniment on the Orchestra Bells. For an encore "Yankee Dandy March" was played.

The Technology Trio rendered a selection from Faust and also a "Hungarian Dance" in a very effective and brilliant style. Mr. Sweet played the violin, Mr. Shaw the 'cello, while Mr. Thode was at the piano.

In the fourth number the Banjo Club played the "Rose Tree March," and were obliged to respond to an encore. They were followed by the Glee Club singing "Doan You Cry, Ma Honey," by Foster. This selection was appreciated by the audience, and two encores followed,—the first a humorous selection, "The Bill of Fare," and the second, "Sleep, My Lady, Sleep," a familiar, tuneful melody, the effect of which was greatly increased by the entire club humming the refrain.

Mr. Shaw, accompanied by Mr. Martin on the piano, showed his musical ability by his fine playing of "Beurceuse" from Godard's "Jocelyn" and again in his encore number of Schubert's "Moment Musical."

With the seventh number, the Banjo Club made their second appearance, playing the "Chinese American March" and responding with an encore of a humorous nature, in which, one by one, the players went off the stage, leaving the leader alone till he, too, urged by the time shown by an Ingersoll watch big enough to take the place of a town clock, beat a hasty retreat.

This novel number called for still another encore, and playing the "Husking Bee," a burlesque of an old-fashioned country Barn Dance was given in a very entertaining fashion.

With the singing of Wonson's "Dear Old M. I. T.," by the Glee Club, accompanied by the Mandolin Club, and Mr. Martin on the Bells, the concert came to a close, the last chorus being followed by a rousing M. I. T. cheer.

The hall was cleared and A. F. Thode's Orchestra furnished the music for dancing.

The matrons were:
Mrs. A. E. Burton.
Mrs. Richard Maclaurin.
Mrs. George Wigglesworth.
Mrs H. P. Talbot.
Mrs. Allyne Merrill.

The Reception Committee consisted of
W. W. Warner.
J. S. Martin.
P. L. Caldwell
J W. Northruj.
H. Lockett.

Another brilliant example of the seaworthiness of the submarine has just been furnished by the British Navy. In all probability, a world's record for an open-sea run was made by the flotilla of ten British submarines in their voyage from oPrtsmouth to Dundee, the new submarine base in the North Sea. Despite the heavy waves and rough weather, the flotilla covered the distance, 512 miles, in 56 hours, maintaining an average speed of 9.8 knots.

VENTILATION OPTION

How the Subject of Heating and Ventilation Has Progressed.

By PROF. S. H. WOODBRIDGE.

A conservative estimate of the costs of heating and ventilating equipments annually installed in the United States is $18,000,000.00. Previous to the time when a course of study in heating and ventilating was made a part of the curriculum of the Institute the character of the systems for which such sums were expended was determined very largely by the rule-of-thumb methods of contractors and shop "engineers." The nature and results of their work are matters of history. The prevailing methods were those of coarse approximation involving large factors of safety stated in terms of a more or less erratic personal equation. The resulting products were more like a big Indian blanket wrapped about the user than like a civilized garment, cut and made to closely fit the form, and to flexibly adapt itself to the motions and requirements of the wearer. All that meant waste, clumsy and costly misfits, with only here and there a nice adjustment of furnishment to requirements.

The problems of ventilation became in such hands a series of expensive and discouraging failures. So late as the early eighties, the Institute was emphatically advised by experienced "engineers," as also by some of their victims, against any serious attempt to provide an effective ventilating system for a projected new building, because "it will prove only one more costly experiment foredoomed to failure,"—"costing a mint of money to install and requiring a mine of coal to run." The Institute took the matter into its own hands and designed and furnished a system which for a decade stood as an object lesson in effectiveness and economy in ventilating work, and played no insignificant part in the evolution which has redeemed theory and practice in the realm of heating and ventilation from the longtime thraldom of a capricious art, and established them on a sound engineering basis.

For two centuries men of note as physicists, chemists and physicians took a leading part in elucidating and applying self evolved principles to the solution of ventilating problems, particularly in connection with the Parliament Buildings in London. These men, such as Desaguliers, Hale, Gurney, Faraday, and Percy of England, most able in their several vocations, were, seemingly, not gifted as aerial engineers. The practical difference between the civil engineer and the aerial engineer is that the sure footing of one is on terra firma, while the tentative footing of the other is in the air. To transpose the former without due preparation into the field of the latter is to impose on him an unwonted task, and to invite embarrassment and failure.

General Meigs, a late chief of engineers of the United States Army, under whose charge the Library of Congress was begun and the Washington Monument, the State, War and Navy building, and the House and Senate Wings of the U. S. Capitol were built, while engaged upon the last-named work, incorporated in his report to his superior, the Secretary of War, a significant statement to the effect that of all the various labors undertaken by him, he found those pertaining to heating and ventilating the most complex and difficult, requiring a knowledge of the nature and laws of heat and its transmission, of the physics and mechanics of gases and vapor, the dynamics of steam, the theory and application of mechanism and an amount of laborious computation uncalled for in his other engineering work, and strongly hinting his purpose to spare his Government that long history of lavish expenditure and lamentable failure which, he asserted, has characterized nearly two centuries of attempts to satisfactorily ventilate the English Parliament Chambers.

The purpose of the courses of study in Heating and Ventilation as pursued at the Institute, on the sides of Hygiene, Architecture, Heat, Pneumatics, Mechanics and allied subjects, is to so equip the graduate engineer who shall have taken the full course that no such confession and humiliating record can be justly written of his professional undertakings.

In modified and mollified form that record might more aptly be written of the work done by the afore named able critic himself and by his accomplished associates, than of that done by an Institute graduate, Course II, Option 4, who has furnished Boston, in the new Opera House, with what is believed will prove to be the finest example of auditorium ventilation the world affords.

DRAWING

How Drawing is Taught and the Aims of the Course.

By PROF. C. P. PARK.

The aim of the courses in Mechanical Engineering Drawing is to give the student ability to make accurate solution of engineering problems by graphical methods, facility in clear expression of his thoughts and constructive ideas by means of drawings, and ease in correct interpretation of ideas of others expressed through the same medium; in order that he may meet the requirements in this direction that will come to him in active engineering practice. The courses, which extend through the student's second and third years, may be considered of two general types,—Machine Drawing and Graphical Solution of Problems.

The work of the second year supple-

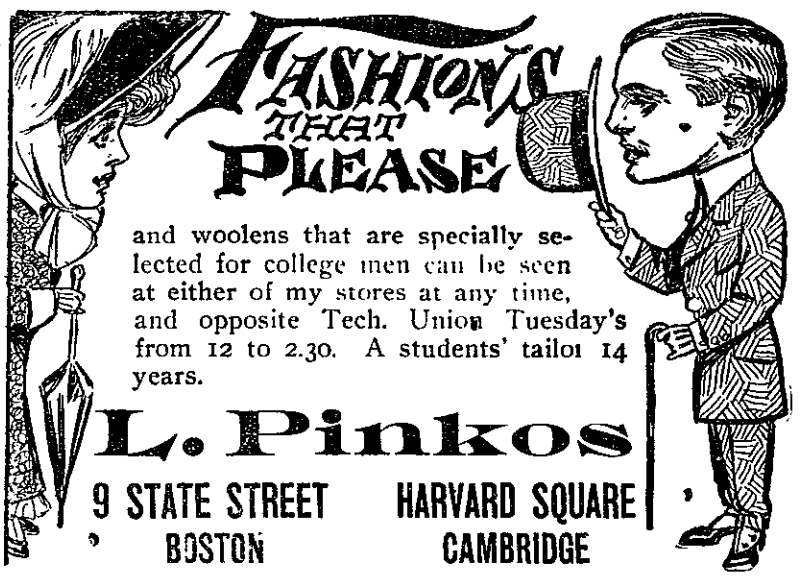
PROF. CHARLES F. PARK.

ments the lecture course in Mechanism, and consists very largely of the solution of problems in kinematics and mechanism design by graphical methods. Much importance is placed on this work; and the problems are of a practical nature, such as problems in belting and quick-return motions, the design of cams, gear-teeth, plain-slide and double valves for steam engines, and the Stephenson link, etc. The study of velocities by means of curves is made largely from data on machines in actual operation so that the student may gain a clear conception of some of the results which are being obtained in modern machine construction. By varying the proportions of such problems in making the assignments to different members of the same class, the student is enabled to see the effects produced by such changes, and investigations of this character carried through several years by the department, give considerable valuable information. The problems in the design of gear-teeth, aside from their importance as such, are considered of great value in teaching accurate use of the drawing instruments; the particularly valuable feature lying in the fact that in such problems the student himself is able to judge of the accuracy of his work, and he soon learns that care and accuracy are necessary to gain results of real value. Besides, the spirit of getting a drawing finished, right or wrong, is discouraged by such problems. In valve-gear design the student becomes acquainted with the practical construction and lay-out of both plain-slide and double valves through the process of the solution of his problem. Furthermore, by the use of wooden models, which the student makes for himself and uses on the drawing board with his other instruments in solving problems on the Stephenson link, he learns the value of special drawing appliances; and an effort is made to impress upon him the wide application of such devices to the solution of engineering problems.

At the beginning of the course, before the student is prepared to take up a problem depending on the principles

(Continued on page 20.)

COBB, BATES & YERXA COMPANY,
SELL CIGARS, CIGARETTES,
SMOKING TOBACCO
AND ALL SMOKERS' MATERIALS
AT
55 SUMMER ST., CORNER OF CHAUNCY


FASHIONS THAT PLEASE
and woolens that are specially selected for college men can be seen at either of my stores at any time, and opposite Tech. Union Tuesday's from 12 to 2.30. A students' tailor 14 years.
L. Pinkos
9 STATE STREET
BOSTON
HARVARD SQUARE
CAMBRIDGE

BACK BAY BRANCH
State Street Trust Co.
130 MASSACHUSETTS AVENUE, BOSTON
Credits interest monthly on accounts of $300 and over.
MAIN OFFICE: 32 STATE STREET

Kuyler's
Confectionery
146 TREMONT STREET,
BOSTON.
Telephone Oxford 3280.

GEM SHOP
601 Boylston St., Copley Sq.
BOSTON.
Christmas Gifts
Unique designs in pendants, scarf pins, brooches, rings, bracelets, hat pins, necklaces in gold and silver.
Odd stones from all over the world.
Abalone jewelry set in sterling silver.

Thos. F. Galvin
ROSES
124 Tremont St., opp. Park St. Church
Telephone Oxford 1737
Conservatories:
Boylston and Fairfield Sts., Back Bay
Telephone Back Bay 2323
Established 1850

SMULLEN & CO.
TAILORS
51 SUMMER ST., cor. Chauncey St.
Highest Grades : Popular Prices

71 Prony brake
72 Belt transmission testing machine
73 Triple expansion Corliss engine, 150 H P.
74 Oil testing machine
75 Air compressor
76 Condenser
77 Corliss steam engine, 16 H. P.
78 Measuring tanks for steam jackets
79 Surface condenser
80 Air pump
81 Steam engine indicator tester
82 Weighing tanks
83 Hydraulic ram, 4-inch drive pipe
84 Apparatus for testing pressure of air on surfaces
85 Cistern for oily water
86 Steam pump
87 Weighing tanks
88 Orifice tank
89 Turbine wheel
90 Hose nozzle
91 4-foot weir
92 Rotary pump

126 Arch
127 Cran
128 12-in
129 Cisten
130 De L
131 Tande
132 Air c
133 Storag
134 Flow
135 Prony
136 Extens
137 Rotar
138 Impul
139 Pulsc
140 Air m
141 Conde
142 Feed
143 Pump
144 Cistern

S INSTITUTE OF TECHNOLOGY.

ERING LABORATORIES.

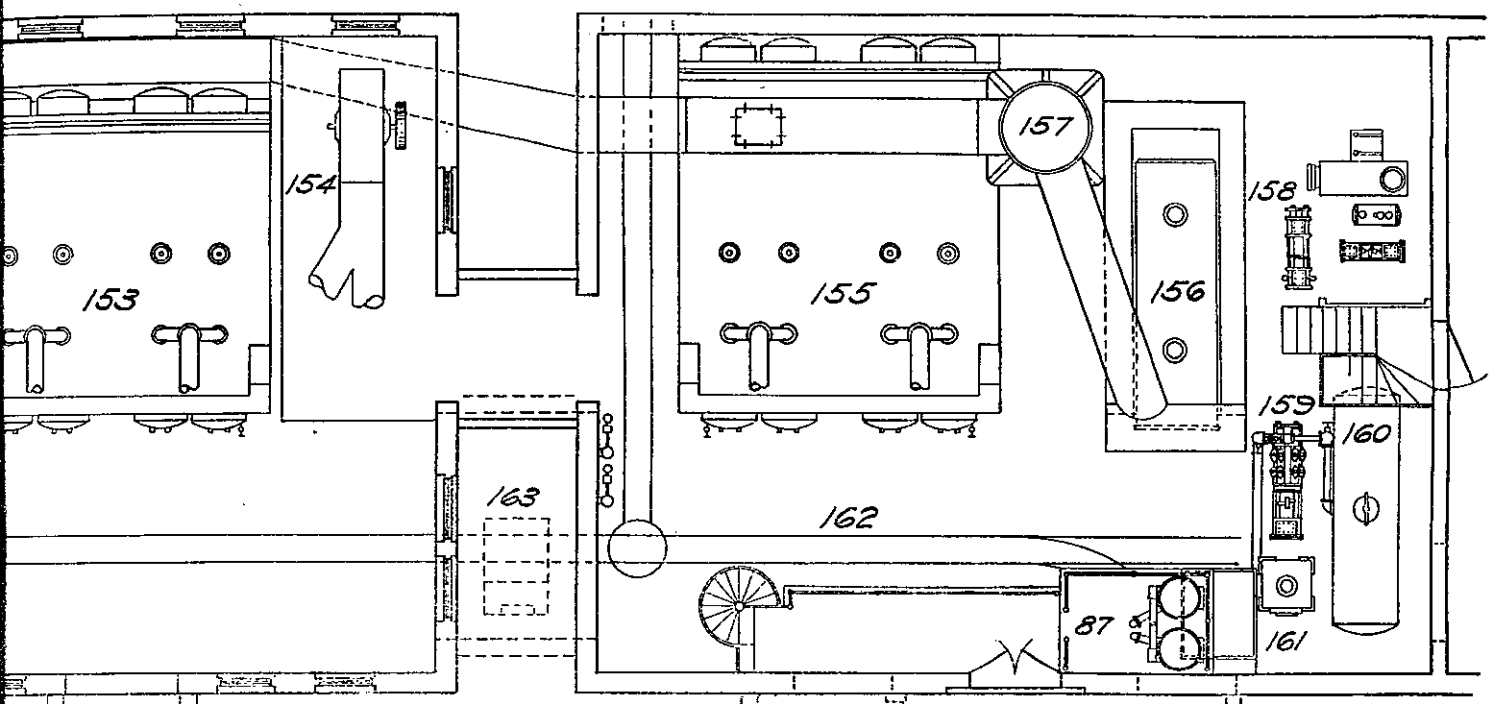
Basement, 18,500 Square Feet.

AND NAMES OF MACHINES ON FLOOR PLANS.

olex steam pump, 16" x 10½" x 12"
ng pump
ver pump
am pump
trifugal pump
tern
someter
ghing tanks
ge testing apparatus
ibrated steel tanks, each 280 cubic feet capacity
ch water meter

104 Fan engine
105 Main coils for heating and ventilating system
106 Rope testing machine
107 Emery testing machine, 300,000 lbs. capacity
108 Scale case for Emery testing machine
109 Power hydraulic pump for Emery testing machine
110 Beam testing machine, 100,000 lbs. capacity, 26 ft. span
111 Beam testing machine, 18,000 lbs. capacity, 14 ft. span
112 Gas engine
113 Torsional shaft testing machine
114 Air brake apparatus for 26 car train

115 Surface condenser
116 Westinghouse single acting engine, 35 H. P.
117 Locomotive air pumps
118 Chain drive testing machine
119 Machine for testing wear of brake shoes and of tires
120 Combination air brake
121 Iron rack
122 Experimental fly wheel governor
123 Experimental pendulum governor
124 Machine for testing coefficient of sliding friction
125 Machine shop



achine, 6,000 pounds capacity
cisterns 129 and 98

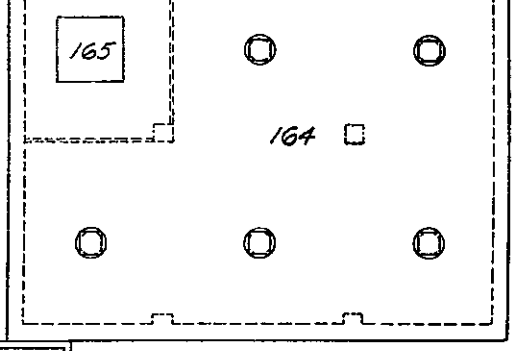
and pump
ne, 200 H. P.
ounds per square inch

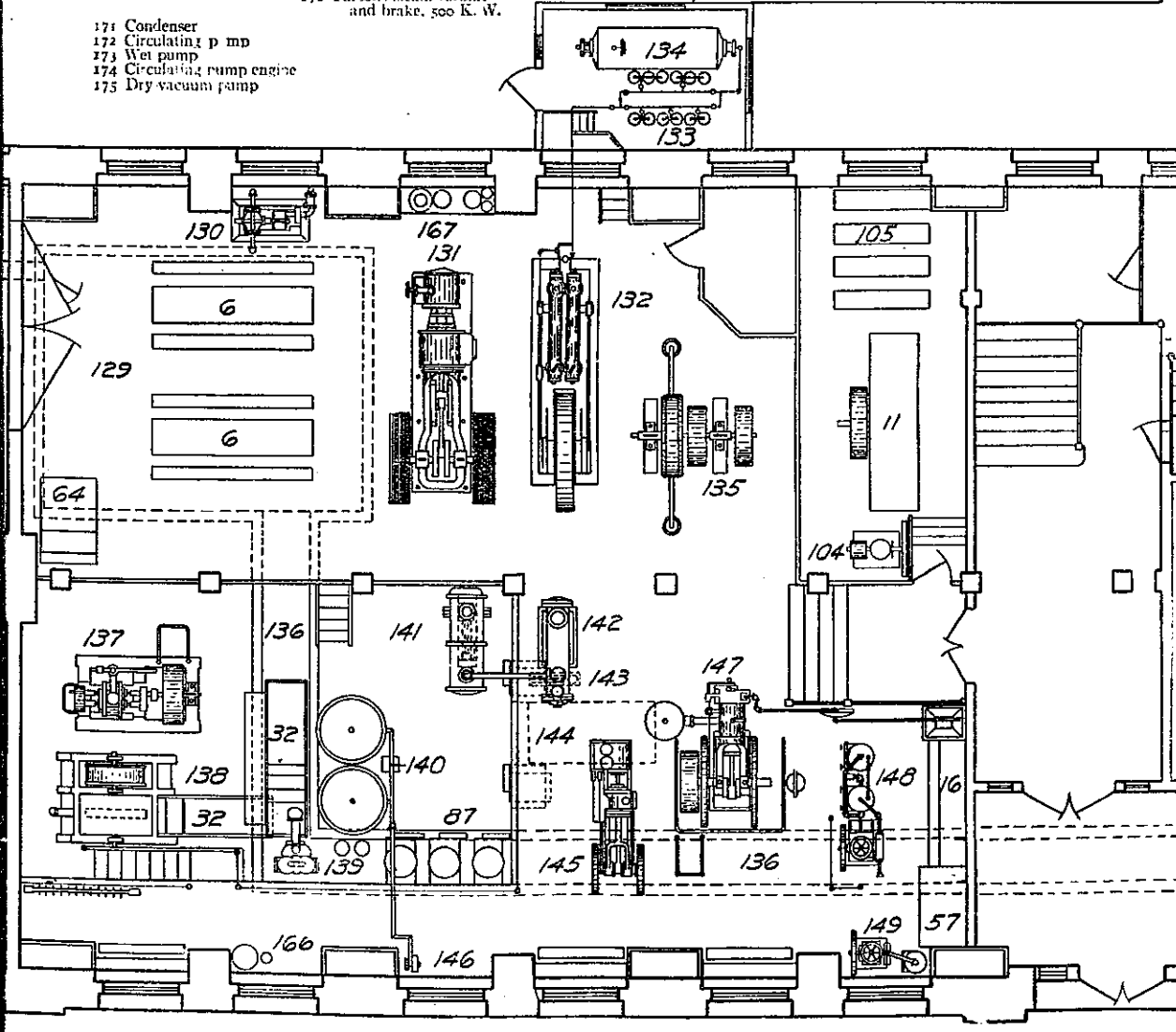
ons per minute

harge
engine

145 Dry vacuum pump
146 Blower for gas engine air tanks
147 Gas engine, 36 H. P.
148 Vacuum cleaner
149 Compressor
150 Carpenter shop
151 Kiln for drying lumber
152 Superheater, independently fired
153 Battery of two boilers, 250 pounds pressure
154 Forced draft fan and engine
155 Battery of two boilers, 250 pounds pressure
156 Steam boiler
157 5-foot stack, 125 feet high
158 Feed pump
159 Feed pump
160 Tank for returns
161 Feed water heater
162 Track for boiler coal
163 Coal scales
164 Coal pocket
165 Ash elevator
166 Flow of steam
167 Liquid air machine
170 Parsons steam turbine and brake, 500 K. W.

171 Condenser
172 Circulating p mp
173 Wet pump
174 Circulating pump engine
175 Dry vacuum pump

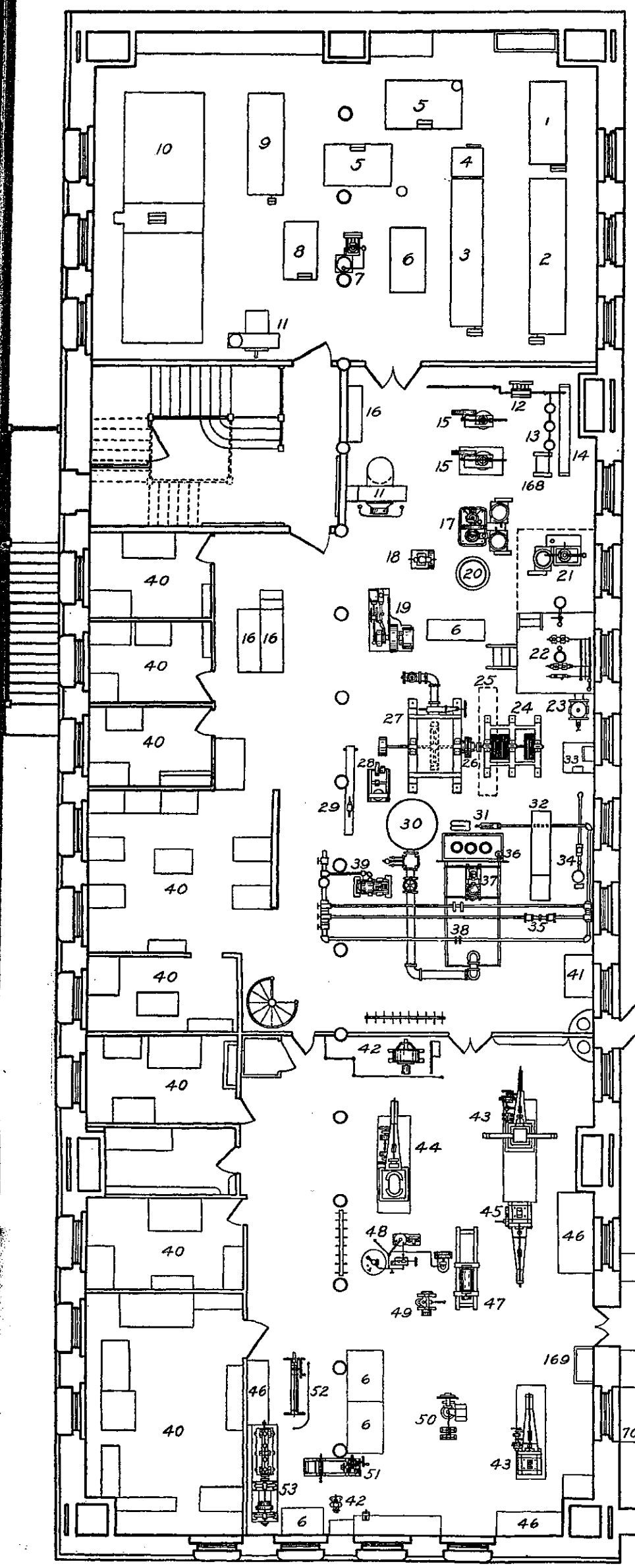




MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

ENGINEERING LABORATORIES.

First Floor, 9,500 Square Feet.



NUMBERS AND NAMES OF MACHINES ON FLOOR PLANS.

1 Drawing frame
2 Speeder
3 Fly frame
4 Railway head
5 Carding engine
6 Tables
7 Drosophore
8 Loom
9 Spinning frame
10 Mule
11 Fan
12 Superheating calorimeters
13 Throttling and Thomas' calorimeters
14 Condenser
15 Hot-air engine (Ericsson)
16 Instrument cases
17 Hot-air engine (Rider)
18 Steam engine, 5 H. P.
19 Steam engine, 8 H. P.
20 Supply tank for hydraulic ram
21 Continuous water calorimeter
22 Injector testing apparatus
23 Apparatus for testing the force of the jet of an injector
24 Brake for Pelton water-wheel
25 24-inch weir (suspended)
26 Emerson power-scale
27 Pelton water-wheel
28 10-inch centrifugal machine
29 Ejector
30 Tank for hydraulic experiments
31 Apparatus for testing hoze nozzles
32 Weir
33 Mercury column
34 Hydraulic stand-pipe
35 Venturi meter
36 Adjustable weir and tank
37 Hydraulic ram, 2½-inch drive pipe
38 Hydraulic apparatus
39 Water motor
40 Offices
41 Gauge testers
42 Electric motor, 20 H. P.
43 100,000 pounds testing machine
44 100,000 pounds testing machine
45 50,000 pounds testing machine
46 Specimen racks
47 Frame for balancing
48 Gas explosion apparatus
49 Webber dynamometer
50 Wire testing machine
51 6,000 inch-pounds torsion machine
52 Cast-iron transverse testing machine
53 Repeated stress testing machine
54 Time test of timber beams
55 Microscope for metallographic work
56 Lubricant testing machine
57 Cases
58 Rope testing machine, 150,000 pounds capacity.
59 60,000 inch-pounds torsion machine
60 Cloth testing machine
61 Impact machine
62 Machine for testing cement
63 Abrasion machine
64 Large weighing scales
65 Cement mixer
66 Briquetting machine
67 Speed cones
68 Emery grinder
69 Speed controller
70 Cement specimen tanks
168 Superheater
169 Physical Balances

LABORATORIES

The Engineering Laboratories Form One of the Institute's Assets.

By PROF. E. F. MILLER.

The Engineering Laboratories consist of the "Steam Laboratory," the "Hydraulic Laboratory," and the "Strength of Material Laboratory." These laboratories occupy a floor space of about 23,500 sq. ft. They are used in the regular work of instruction by the Mechanical, Civil, Chemical, Sanitary, Electrical and Mining Engineers, by the Naval Architects and by the Naval Constructors.

In addition to the above, many students make use of the apparatus contained in these laboratories in carrying out investigations made in connection with some thesis.

The plans of these laboratories, given on an accompanying page, show the location of the larger machines. A study of these plans will give one some idea as to the scope of the instruction in testing and to the great variety of apparatus, with which a student must become familiar.

There are many Laboratories in Germany, and some few in this country, which in variety and in amount of equipment in some one branch are superior to our engineering laboratories, but considering the Steam, Hydraulic, and Strength of Material Laboratory as a whole, the Engineering Laboratories of the Institute are still in the front rank.

In the Engineering Laboratory the objects sought are the following:—

1. To give the students practice in such experimental work as engineers in the pursuit of their profession are called upon to perform.

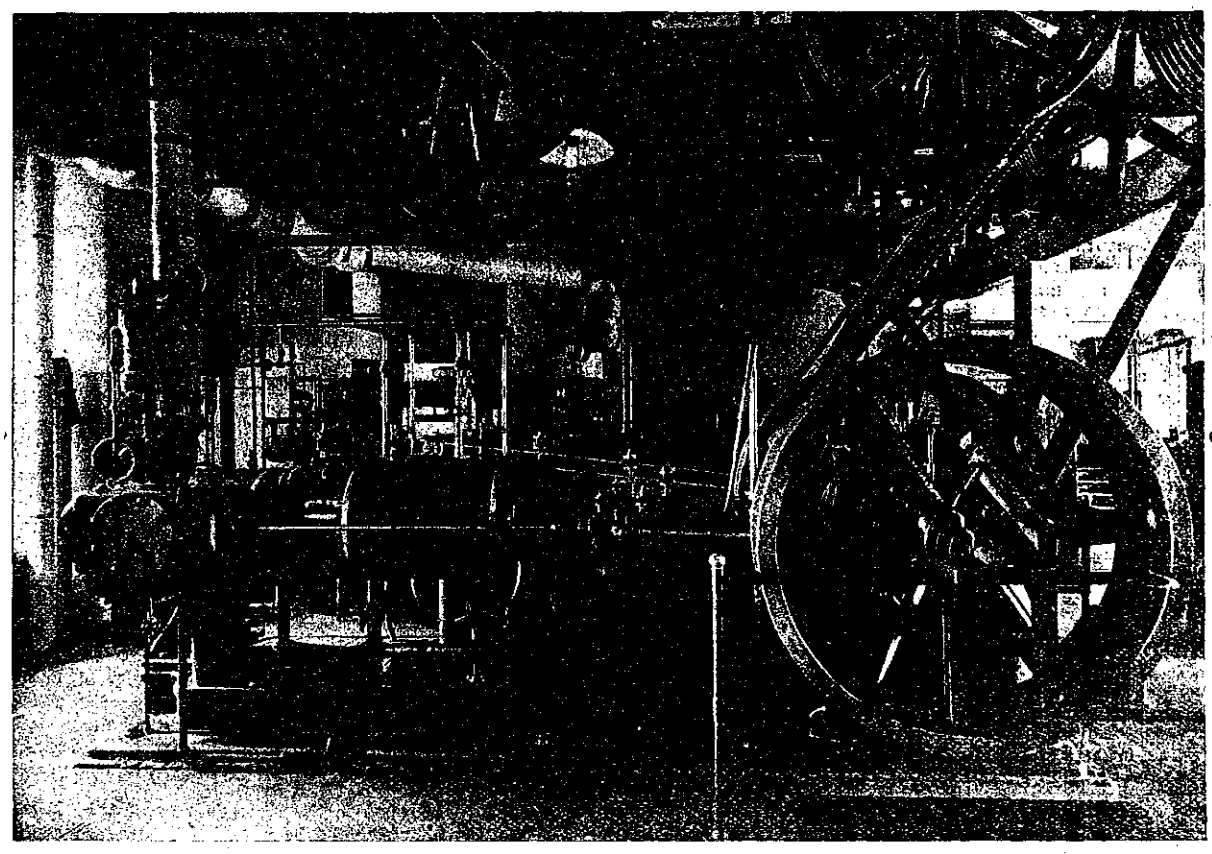
2. To afford some experience in carrying on original investigations in egnineering subjects with such care and accuracy as to render the results of real value to the engineering community.

3. By publishing from time to time the results of such investigations, to add greatly to the common stock of knowledge.

4. By a systematic series of tests made on new machines either presented or loaned to the Institute to aid the manufacturer or the designer in improving or in perfecting such machines.

The primary object of the laboratory is to give instruction in the methods of conducting tests. Students are not admitted to the laboratory work unless they have had the theoretical work necessary to enable them to conduct the experiment and make the necessary calculations intelligently. On this account, it is possible in a two-hour period for a student to do a considerable amount of experimental work, because none of the time is used up in explaining the principles involved or methods of calculation required. Some details about the installation and certain constants, are all that the student needs before beginning his work.

The various tests which the students are called upon to conduct are so chosen as to illustrate the various methods which a mechanical engineer would use in the measurements of steam, water, gas, air, in the determination of efficiences and in the calculation of power.



During the past two or three years it has been the custom to assign the men to the work in squads of three, one man of the squad having charge of the test, and the other men in the group reporting to him as they would to an engineer for whom they were working. This man in charge of the group decides on what observations should be taken, how often these observations should be taken, and which of his observers should be assigned to certain stations. From day to day the man in charge of the squad is changed so that every student in the course of the senior year takes charge of at least 16 tests.

Each and every test made by a student is calculated and reported by that student. His results are compared with those obtained by the instructors in the laboratory who calculate every test, using the data obtained by the students.

Students first begin their laboratory work in the third year, where they are made familiar with the use of the steam engine indicator and are taught how to make engine tests. Three engines are run for this work, a 150 H. P. triple expansion Allis, a 200 H. P. McIntosh & Seymour, and a 450 H. P. Russell Engine. Each student makes complete calculations of three of these tests determining by the necessary thermodynamic equations the quality of the steam at cut-off and at release, and the British Thermal Units per horse power per minute. He also plots on the temperature entropy diagram the expansion line between cut-off and release.

The apparatus in the Engineering Laboratories is used to a great extent both by the students and by the instructing staff in carrying on original investigations. Many of these investigations are undertaken at the suggestion of some engineer or some manufacturer who has some technical or mechanical problem which he cannot solve.

Of late a considerable amount of new apparatus has been presented to the Institute with the understanding that the donor was to have the benefit of any improvements which might be suggested as a result of the tests made on the apparatus.

As a larger amount of new apparatus is installed each year than the old removed, the laboratories have become very much crowded. This crowding is felt especially in the Strength of Material Laboratory, where there is no room for the storage of, or for the manufacture of large concrete beams. At present such beams must be made outside and carted to the laboratory for test, and then removed before other beams can be brought in.

MECHANICAL ENGINEERING.

(Continued from page 14.)

regular laboratory work and partly by means of the thesis work, may be classified as follow:—

(a) Those made in the laboratory itself.

(b) Those made at some outside plant.

In the case of the first, many have for their object the determination of results of value to engineers and manufacturers, and others engaged in industrial pursuits. The engineering labora-

PROF. ALLYNE L. MERRILL.

tories are often the means of giving direct aid in solving industrial problems such as determining the efficiency of new

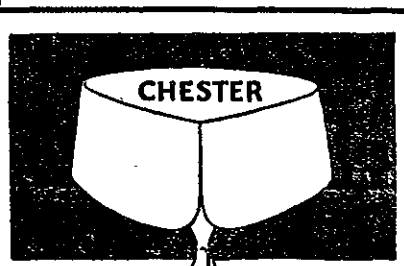
(Continued on page 22.)

SAVES TIME
TO BUY OR SELL
THE
BOSTON
GARTER
KNOWN TO EVERYBODY
WORN ALL OVER THE WORLD
MADE WITH Velvet Grip CUSHION RUBBER BUTTON CLASP
OF ANY DEALER, ANYWHERE
or Sample Pr., Cotton, 25., Silk, 50c.
Mailed on Receipt of Price
GEORGE FROST CO.
MAKERS, BOSTON
OVER 30 YEARS THE STANDARD
ALWAYS EASY

STONE & WEBSTER
CHARLES A. STONE, '87 EDWIN S. WEBSTER, '87
RUSSELL ROBB, '87 ELIOT WADSWORTH, '03 HENRY G. BRADLEE, '91
Securities of Public Service Corporations
Under the Management of our Organization
STONE & WEBSTER MANAGEMENT ASSOCIATION
GENERAL MANAGERS OF PUBLIC SERVICE CORPORATIONS
STONE & WEBSTER ENGINEERING CORPORATION
CONSTRUCTING ENGINEERS

Miss M. F. Fiske
THE RED GLOVE SHOP
322 Boylston St., opp. Arlington
is showing a handsome shade in men's chamois gloves at $1.50 a pair. Other makes at this price are Fownes and Dent's in the popular cape leather in handsome shades of tan.

STATIONERY
Fraternity Stationery.
Engraved Invitation,
Reception and Visiting Cards.
Banquet Menus.
Coats of Arms, Crests and Monograms.
Students' Supplies.
Ward's SAMUEL WARD CO., 51-63 Franklin St., Boston.



AN ARROW COLLAR
with the Ara-Notch in place of the bothersome buttonhole 15c. each—2 for 25c.
Cluett, Peabody & Co., Makers
ARROW CUFFS, 25c. a Pair

Fall and Winter Novelties
C. A. Patten & Co.
MERCHANT TAILORS
43 Tremont St. Carney Bldg.
Nobby Suits at Popular Prices

GRADUATES' LETTERS

Answers to Letters Sent to Representative Men.

To the Editor of The Tech:

The following statement may be of interest, as an answer to your inquiry as to how my course in mechanical engineering at the Institute has been of value to me in my business.

While my business is a manufacturing one, my part of it does not require so much actual mechanical engineering as many others do, but certainly the training received at the Institute has aided largely in the forming of judgments when necessary in making alterations and improvements.

I feel that the greatest benefit derived from the course at Tech is the ability to keep my mind on a subject regardless of what is going on around me, as concentration of mind is of the utmost importance in handling many things simultaneously.

—G. L. Gilmore.

Contracting is one of the kinds of work for which training and experience in business as well as in engineering, make the best equipment if a man is to climb to the top. Contracting is highly specialized. Frequently twenty or more contractors, each doing one kind of work, will be found upon one job. Sometimes all of these are put under one general contract and sometimes engineers or architects assume these duties and let each kind of work directly. There is a growing (and praiseworthy) tendency to use what might be called an engineer contractor. This man finances the work, manages the operations of all sub-contractors and makes approximate prices, with guaranteed maximums if desired. The work is done at cost and the engineer contractor receives a commission for his services.

Whatever be the method of carrying out the work as laid down by engineer or architect, engineering skill is valuable and often necessary for the contractor. Obviously in some of the special lines others of Tech's courses are of more value—but Course 2 (mechanical engineering) is the most suitable equipment for the larger number. All kinds of contractors have machinery—in mills or shops and upon the construction work. Iron work, wood work and mason work, together with strength of materials, one must know much about. Walls, piers, arches, beams, columns and trusses must never present problems beyond appreciation. The combination of high quality and economy of output may often best be studied from an engineering poin. of view. Physics, mechanics, thermodynamics, etc., are often a great assistance—and that man builds his reputation who can "say why" upon the problem up for solution.

It is apparent that contracting covers many lines of activity. The range between an Eiffel Tower and the East River Tunnel, a North Dakota or Lusitania and a gian city building or millionaire's palatial home, is very wide. The smallest of this work— it may be a very small house, a comparatively insignificant piece of excavating or some other little thing—will often present its problems. It is a common occurrence to be able to watch the handling of men, materials and equipment of a contractor and see that he shows training in engineering lines. This training to a certain extent can be picked up outside but the best and easiest partial preparation for it is in Course Two at Tech.

Fred A. Wilson.

To the Editor of The Tech:

You have asked me to express my views upon the subject of "the mechanical engineer in the field of reinforced concrete," and it gives me pleasure to offer the following rambling thoughts on this subject.

It is rather difficult to determine exactly what the editor had in mind, but let us start with the idea that he wished my opinion on the value of a mechanical engineering education as a preparation for work in reinforced concrete. If this supposition is correct then I unhesitatingly say that the courses given in most technical schools under the head of "mechanical engineering" are not the best for a man who intends from the start to enter the field of reinforced concrete or any other line of structural engineering. The usual mechanical engineering course is not strong on such matters as "beam theory," "strength of materials," "structures," etc. and at least a fair working knowledge of these subjects is essential to successful design in either reinforced concrete or steel structures.

In general these subjects are covered much more thoroughly in the so-called "civil engineering course," and if a young man on entering a technical school, has already decided that the field of reinforced concrete or other structural work is without question to be his life's work, then he can probably more readily prepare himself for immediate usefulness in this line of work by confining his study to subjects usually classed as "civil engineering."

As regards M. I. T., however, I beg to suggest that "mechanical engineering" education as expressed in the work of Course II is far stronger on these subjects than is usually the case, and there is no reason why a graduate from this course should not "make good" in the reinforced concrete field, provided he is endowed with a fair amount of plain horse sense, which is an asset that cannot be conferred upon him by any college course and which is essential to success in any field.

Let me, however, urge upon the youngster just about to choose a course, not to undertake to determine just what special branch of engineering he is "going to take up on graduation." Ten chances to one before he completes his course he will make the startling discovery that there are other important special branches of engineering, which have been hidden to his youthful eyes and some one of them may lure him away from his first love. Moreover, the young graduate usually wakes shortly after receiving his diploma to the awful fact that there does not appear to be any immediate demand for men in the specialty he has picked out, and "filed upon" as his own. Soon hunger or some other powerful incentive induces him to accept (always temporarily) a position in some other field and then he congratulates himself or curses his instructors (rarely the reverse) according as his course of training has been along broad general lines or some narrow specialty. He now should realize that the fussy old "prof" who continually urged upon him the necessity of getting himself well grounded in the fundamentals even at the expense of his much cherished hobby, was his best friend.

A word more specifically as to the several engineering courses at M. I. T. To every young man who has a taste for things mechanical, who likes "to see the wheels go round," make things with his own hands and particularly if he has a taste for mechaanical drawing, I would say by all means, choose Course II. If wiring door bells, building telephone and telegraph lines or similar efforts seem to be the height to which only the elect may rise choose Course VI. If sighting through a transit or a level, climbing over rough paths with a rod or chain, or some day designing a roof truss appeals to the juvenile fancy, choose Course I, but whatever course you choose, don't for a moment lose sight of the fact that it is all engineering, and that the other fellow's work is "just as important and more so," and to a real naturol-born engineer, any problem in any branch of the profession is of interest.

To the writer's way of thinking there should be no distinction between civil, mechanical and electrical engineers until, after years of hard practice, men have proven themselves competent to specialize. What would we think if a medical school gave one man sourse of surgery and no therapeutics or vice versa? Would we care to consult an aurist or an oculist who knew nothing about the throat and nose? The only "doctor" who may be permitted to study one and only one specialty or to practice it without thorough and general training in all branches of medicine and surgery is the "corn doctor" and it is not necessary to say more as to his professional (?) standing.

Let us then do all in our power to eliminate the "corn doctor" equivalent from the engineering field and when we shall have done so and only then, can we demand for engineering admission to the ranks of learned professions. Breadth, breadth and more breadth should be our watch-word.

Howard L. Coburn.

STEAM TURBINES

Fourth Year Option Deals with Design and Construction.

By PROF. C. H. PEABODY.

The option of steam-turbine engineering was begun last year to meet a growing demand for instruction in the essentials of the design and construction of steam turbines.

This subject is so recent and the methods that have been evolved in practice have been so guarded, that textbooks and other publications give only the general methods with but little detail, either of computation or construction. The work of preparation of the option has been largely the evolution of

(Continued on page 21.)

MARINE ENGINEERING.

(Continued from page 11.)

the engine; (4) the computation of stresses in those members and the determination whether the engine is properly proportioned.

The methods outlined above are those used in marine engine establishments, and differ from actual practice in that the educational methods must be emphasized and the time given to elboration of detail, especially in the drawing room, must be minimized. Having such an investigation for a series of engines, the designer can readily so adjust the factors for the simple approximate methods as to control his design.

The drawing-room work includes the design of a propeller for the engine selected for design and computation; the drawing of the reciprocating parts, piston, rod, crosshead and converting-rod, and the determination of weights; an assembly drawing sufficient to determine the adequacy of the design; and the general arrangement of engine room.

The option includes also the discussion of the vibration of ships on account of the pulsation of the engine and of the methods of balancing enines to minimize that effect.

MECHANICAL ENGINEERING.

(Continued from page 15.)

of mechanism, he is given work which is intended to familiarize him with accepted conventions of representation and certain standard machine details such as bolts and nuts, screws, springs, keys, pipe-fittings, etc. Each student is furnished with a set of plates and tables giving the sizes and proportions of such of these machine details as may be considered standard, and in working from these data sheets he gains some practice in machine detailing preparatory to the course in machine drawing, and he also acquires a certain sense of the proper proportions to be used in machine designing.

In all the courses a definite number of hours is allotted to each problem or assignment of work in order that the student may form an idea of the amount of time that would be needed by a practicing draftsman to accomplish the same work. Failure to get drawings finished before a fixed date, allowance having been made for some overtime, influences the student's record of standing. Effort is made to teach the students to think clearly and to execute their work accurately, but this in a reasonable length of time.

A system of approving drawings has been adopted which promotes more thoroughness on the part of the students and which takes the place of the system of checking now so generally in use in modern drafting rooms.

THE NEW AMERICAN HOUSE BOSTON
VISIT THE RATHSKELLER
A homelike, first-class hotel, proud of New England traditions, dating from Gen. Warren, yet newly furnished with every comfort & convenience
Long distance phone and hot and cold water in every room. Kept constantly clean by our vacuum plant. Rooms $1.00 a day and up.

J. C. LITTLEFIELD
HIGH CLASS TAILOR
Smart and effective fabrics, the latest texture and the most fashionable shades, prices that are right.
DRESS CLOTHES A SPECIALTY.
12 Beacon Street, Boston

"The Girls Are Fond of These"
Tech Emblems
Greatest Variety
Lowest Prices
BENT & BUSH
15 School Street BOSTON

All Goods Required by Students at
Maclachlan's
502 Boylston St.
Drawing Instruments and Materials, etc.
Fountain Pens, Text-Books

IT SEEMS TO BE A GENERAL OPINION THAT THE FOOD AT THE UNION LUNCH ROOM IS ALL RIGHT. "COME AND GIVE US A TRIAL."
TECH UNION.

Lombardy Inn
Italian Restaurant...
Table d'Hote Dinner 5 to 8.30
A la Carte
STRICTLY ITALIAN CUISINE
ITALIAN WINES
BOYLSTON PLACE
Near Colonial Theatre
BOSTON, MASS.
Telephone Oxford 2942

LANDERS'
Lunch and Coffee House,
20 HUNTINGTON AVENUE,
NEAR COPLEY SQUARE,
327 MASSACHUSETTS AVE.
Tel. 3195-1 Back Bay BOSTON

Preston's
Coffee House
Open All Night.
1036 BOYLSTON STREET, BOSTON
Telephone 2206-1 B. B.

OLD ESTABLISHED
DINING ROOM
A. G. COTTON, Propr.
33 St. Botolph St.
Best Board in Back Bay.
Reasonable Rates.
We make a specialty of serving Tech Students.

"THE LITTLE PLACE 'ROUND THE CORNER"
COPLEY LUNCH
QUICK SERVICE

STEAM ENGINEERING.

(Continued on page 21.)

the gas engine and gas producer. The temperature entropy diagram is used to a considerable extent in the solution of problems. To enable the student to apply his thermodynamics, various points are illustrated by applications to practical problems, and the student in the course of his work is made to solve a great number of such problems.

About fifteen lectures in the course are given to the discussion of gas engines and gas producers. The subject of steam boilers is also included in the course. The different types of boilers are discussed, and the students shown how to select the proper type of boiler for a certain set of conditions. The thermal efficiency of boilers, boiler settings, boiler staying, the effect of scale and the methods of removing scale, are treated at considerable length. It the intention to bring before the student in this course, practically every type of problem along steam engineering lines, which he may meet in practice, and it is felt that the student, after taking such a course, is able to grapple successfully with any problem whih may confront a steam engineer.

STEAM TURBINES.

(Continued from page 20.)

methods that can be advantageously used for education, and which give substantially the results that are known to be atained by turbine builders. Fortunately turbine builders have recently found it possible to give sufficient information to insure that methods, which in themselves are valid, are so controlled as to give results that closely parallel thase that have been found advantageous in practice.

The temperature-entropy table was computed for use in steam-turbine computation at the Institute and has proved to be rapid and accurate in use, and allow of the development of certain methods that could not otherwise be used. Among these may be mentioned a method for determining directly the proper distribution of pressure in compound steam turbines, taking account of the increase of entropy due to friction. A direct analytical solution is given of the determination of the angles for nozzles, blades and guides of velocity compound turbines, allowing for friction; this method is used for a construction which has two moving wheels in the same pressure stage. For constructions with three or four wheels, this method does not give convenient forms of blades and guides; consequently a graphical method has been devised which gives control of the form of those elements and at the same time ensures high efficiency.

Well-known types of turbines are selected for computation, such as the De Laval, the Rateau, the Curtis and the Parsons. The simplest type is considered first, and the problems are further simplified by restricting attention at first to the more essential details. After some facility in computation is attained secondary details are also considered. This gives admirably progressive character to the work, especially as the more complex types are naturally the ones in which the details lead to greater intricacy.

The more essential details of each type considered are worked out in the drawing room, and for the later problems more attention is given to construction and to consideration of strength.

MACHINE DESIGN

Teaches Application of Applied Mechanics to Design.

By PROF. PETER SCHWAMB.

Comparatively few machines are of such a character that they can be designed from a purely scientific basis, the stresses are often very complex and sometimes indeterminate and successful precedent in such forms our most reliable guide.

The main object of the course, comprising 150 hours of lecture and drawing room work, is to teach the application of the principles already learned to the solution of problems in design. For each design the constructive details are discussed and carefully studied and such analysis of the problems is made as will enable the student to determine the dimensions of each part by principles already mastered rather than by the application of empirical rules. The scope of the problems is such as to include most of the elementary principles of machine design, and yet is sufficiently limited to enable all the necessary calculations and a complete working drawing to be made for each design. It is believed that only by close attention to details and through thorough work can real benefit be obtained.

The work begins with the design of a horizontal multitubular boiler, including a careful discussion of riveted joints,

PROF. PETER SCHWAMB.

bolts, and bolting flanges, methods of staying flat surfaces, design of beams of non-uniform section, and reinforcing rings. Then follow the design of a large transmission shaft with its couplings, bearings, pulleys, and gears, involving a consideration of compound stresses; the design of a crane, a power pump, etc.

MECHANICS ARTS

Training of Mind and Eye as Important as Proper Knowledge of Tools.

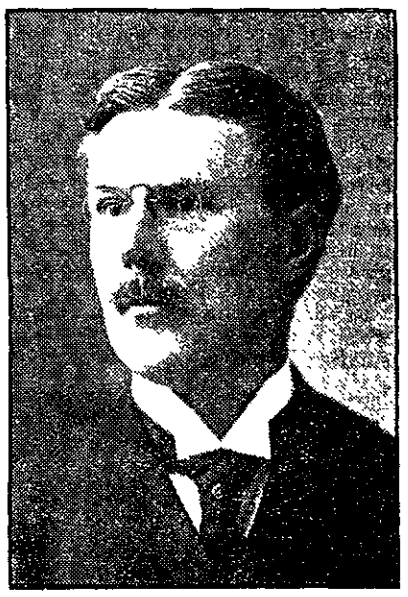
By PROF. PETER SCHWAMB.

The instruction in the mechanic arts at the Institute has two main objects in view:—

1 The training of the hand and eye, and through them the mind, by means of the operations in the mechanic arts.

2 The acquisition of a knowledge of the ordinary materials of construction, of the proper use and familiarity with the hand and machine tools used in the various arts and what can be accomplished with them.

The aim of the instruction is not to teach a trade, but to give a systematic training in the fundamental typical operations involved in each art by means of a carefully planned series of projects or models. The instruction is not confined to explaining how the work should be done, but why as well, thus giving mental as well as manual train-



PROF. GEORGE B. HAVEN.

ing. The systematic training and rapid advance of the student, precision, diligence, the cultivation of the powers of observation, judgment and foresight, and orderly habits, rather than manual dexterity, are the main ends sought: yet sufficient practice is always given to enable good work to be done. Instruction is mainly oral, each new operation being discussed and carried out be-

(Continued on page 22.)

412 Washington St. HAT SHOP Sphinx HAT MAKERS
The Sphinx
The Mallory
Two and Three Dollars

THE STUDENTS' DRUG STORE
Under Copley Square Hotel.
We make a special effort to merit the patronage of our student friends. Don't forget the address under the Copley Square Hotel.

The Rosary
FLOWER SHOP
214 CLARENDON STREET
BOSTON
Telephone 3187 Back Bay.

OWN A TYPEWRITER
If you haven't the cash we sell you one on
EASY PAYMENTS
WE HAVE ALL MAKES AND ALL PRICES
MODEL TYPEWRITER INSPECTION CO.
165 DEVONSHIRE STREET 26 ARCH STREET

OUR SPECIAL OFFER:
Full Dress Suits to Measure,
Silk-lined Throughout
At $45.00
NOBBY BUSINESS SUITS, $30.00 TO $35.00
C. A. PATTEN SAM'L W. FLEISHER.
C. A. PATTEN & CO.
Merchant Tailors
43 Tremont Street, Carney Building
BOSTON, MASS.

CONCRETE ENGINEERING

Co-operation with Local Engineering Firms Aids Department.

By PROF. H. W. HAYWARD.

During the last few years very rapid advance has been made in concrete construction. It is not so very long ago that a reinforced concrete building was a novelty and attracted a great deal of attention both from the general public and the engineering profession, while now this type of construction rivals the steel, brick and other types that formerly were considered best, and in the future it bids fair to become one of the most common methods of construction for building and other structures.

The argument against concrete construction that can be advanced by the advocates of other types, is its liability to weakness from poor workmanship, due to inadequate inspection or because of carelessness on the part of the engineer or contractor in selecting the component materials.

On account of the great variation which is liable to arise in the materials entering into the construction of reinforced concrete slabs, beams, columns or footings and the fact that these materials have very different properties, the ordinary methods of design cannot be used and other theories and formulae are necessary.

PROF. HARRISON W. HAYWARD.

The complex nature of the material in question has given rise to considerable difference of opinion concerning the distribution of stress through various parts of structures. Several different theories have been advanced by eminent investigators in the United States and abroad and each has its advocates among engineers of construction. At present the desire of many engineers seems to be to have at hand a formulae which will give safe results without regard to theoretical exactness. All working formulae contain constants obtained from tests made on full sized specimens and from the nature of the material this will always be the case.

In view of the importance of reinforced concrete as a material of construction and the facts just mentioned, all graduates from engineering courses should have as clear knowledge as possible of the fundamental principles of design, the ability to carry out tests and to draw correct conclusions from the data thus obtained. In addition the man who intends to take up concrete work as a profession, should have an intimate acquaintance with the constituent materials obtained from close contact with them on the mixing floor and as poured on the forms.

Since 1901 there has been carried out in the Laboratory of Applied Mechanics at the Institute as thesis work, tests on six sets of beams, three sets of columns and two arches, and in addition quite a number of investigations have been undertaken concerning the bond strength between concrete and the reinforced steel, and on the strength of concrete in shear and direct compression. Many tests have also been made upon cement and mortar under varying conditions.

Lack of facilities at the Institute has made it necessary to secure the cooperation of engineering firms in the preparation of specimens for these tests. They have responded very well and this year another set of beams, a large number of compression and other specimens will be tested as thesis work in the Applied Mechanics Laboratory; these specimens being provided by a Boston engineering firm which hopes to settle some of its perplexing problems by this means.

At the present time any advance work in connection with reinforced concrete is limited to investigations undertaken as theses and the men doing this work are the only ones to get any experience in mixing, proportioning or placing, although all engineering students have an exercise in cement testing in their regular laboratory course.

The growing importance of reinforced concrete as a structural material will make it advisable in the near future for all men in the engineering courses at the Institute to have some laboratory instruction along the lines specified above, something which is now impossible owing to lack of room where mixing machines could be installed, specimens constructed and stored under different conditions before being tested.

GRADUATES OF COURSE II

(Continued from page 12.)

of small tools, electric specialties, pianos, textiles, thread and twine, paper, automobiles and motors, sewing machines, steam specialties, wood-working machinery, firearms, etc.

A small per cent. of the Course, though connected with manufacturing or engineering firms, are secretaries, treasurers, or financial agents whose duties do not call for technical knowledge of the output. Grouped with them are cost managers, shop organization specialists, and "production engineers." The two latter classes must necessarily study the product and process to a considerable extent, in order to recommend the changes in methods and organization which will increase profits. They are employed by manufacturing rather than engineering firms.

One man out of every thirteen that studied Course II, is now a teacher. For the most part they are connected with technical schools like our own, but some are in the high schools as teachers of mathematics, science, and mechanic arts.

In this list, less than three per cent. are classed as consulting engineers. The term has been restricted narrowly, to include men who advise, design, or superintend construction or who examine and test plants for their clients. If they were regularly employed by a firm, or if they carried out construction in works of their own, they would be classed in groups 1, 2, or 3.

Attention is called to the proportion of graduates engaged in patent law and in factory insurance engineering. The insurance men are engineers who investigate the merits of various devices and apparatus for protection against fire, and inspectors who make periodic surveys of mills and factories to see that the protective apparatus is kept in efficient condition.

Item 12 shows that only one man in eighteen has engaged in work of a completely non-technical nature, for which the course of study pursued at the Institute was not the best preparation and may have been a waste of time. This group includes merchants, brokers, artists, physicians and farmers. In some cases very likely the men gave up the work to which their school training naturally led them, because they realized they could not succeed; there are other cases, however, where it is known that through inheritance or by some mere chance, opportunities too good to lose came to these men, and they wisely chose the more profitable or more desirable openings.

For the majority of Course II's men, was the course they studied in school the best that could have been arranged? Probably not, for any one man or group of men; the course was planned for all. Mathematics, at least through the calculus, the elements of chemistry and physics, mechanics, drawing, mechanism, and mechanical design, are unquestionably advisable for all. Of equal importance are literature, history, economics, and the languages, studies that develop a man's general culture and bring him into closer understanding and sympathy with the world at large, and make him a better citizen. The more technical studies, applied mechanics, thermodynamics, hydraulics and the testing of machines or materials may be justified on two grounds: firstly, their value in training a man to think. Mathematics is supposed to fill this purpose, but the numerical problems of these applied sciences are not usually in the stereotyped form of pure mathematics, and the mental consideration of the various related conditions by which correct solutions of practical problems are effected, is probably of greater educational value than the study of mathematics per se. Secondly, the subjects just named have a direct value as information quite indispensable to men in certain vocations. But let us not overestimate this importance. Look at the list of men above. Most of the engineers, nearly all of the teachers, a very few managers and perhaps half the designers and draftsmen apply daily at least some knowledge of one or more of these subjects. The rest seldom have occasion to use this knowledge, so seldom that they cannot trust their ability to solve the problem correctly, so they turn it over to someone more expert. Nevertheless, these subjects, applied, thermodynamics, hydraulics, and engineering testing, combined with a study of dynamo electric machinery, probably form the best combination that can be arranged, from which a man can branch out along any of the lines which our graduates have followed.

The more strictly technical subjects, such as heating and ventilation, mill, locomotive, or marine engineering, industrial management, steam engine design, refrigeration, concrete construction and other professional work, could be studied to much better advantage if the student only knew which ones to select as directly applicable to his future work. But this he cannot tell, partly because while in school, he may not know just what he wants to do in after life, and partly because regardless of his desires, the work into which he will finally settle is so largely a matter of chance.

LABORATORIES.

(Continued from page 19.)

devices, or the relative advantages of different methods of construction.

In the case of the second class, a part of the investigations are of so much value to engineers, manufacturers, and others, that in many cases the owners of the plant have furnished the use of their apparatus and have often spent considerable money to fit it up.

As to opportunities for work, it will be sufficient to say that, notwithstanding the number of graduates in mechanical engineering is very large, the total number of those graduated in this department being thus far, nine hundred and sixty-five, the demand far exceeds the supply.

FRESHMEN LOSE AT BASKET-BALL

Winchester High defeated the Freshman Basket Ball Team at the Winchester High School last night, the score being 34 to 23.

The first half was played in good fast style, with lots of "slugging" mixed in. During the second half of the game, Crocker, left forward on the 1913 team, fell and hurt his leg.

The line-up of the Freshman team was:

R.F., Balch, Darling; l.f., Crocker; c., Johnston; r. b., Darling, Muther; l. b. Thompson.

Prospects so far for a winning track team this winter are not very good considering the small number of men who have shown up. The old men have evidently the idea that they do not need practice or feel sure of their places. Only thirty men have so far reported to Coach Kanaly for practice and these are mostly under-class men. These men have the right spirit and are showing it more than the upper-class men. Practice is held every Monday at the B. A. A. board track on Irvington Street, every Tuesday, Wednesday, and Thursdays at the Tech Gym. All the events will be practiced from 4.15 to 5.30.

Robert Contesse has been elected by the Swiss Parliament to succeed Adolphe Deucher as president of the Swiss Confederation for 1910. Maro E. Ruchet, a former president, was chosen vice-president to succeed Comtesse. Both executives are elected for the term of one year by the Federal Assembly in joint session of the national and state councils.

MECHANICS ARTS.

(Continued on page 21.)

fore the class just before the work is to be undertaken. As a rule the entire class is engaged upon the same or similar projects, and all work is executed from suitable working drawings.

In the planning of a series of exercises, care is taken not to embody too many operations in one project, the instruction in the elementary operations being the main end sought, rather than construction. Useful projects are, however, always introduced whenever practicable. Experience has shown that this method of instruction enables rapid advance to be made and that after completing the various courses students can do good commercial work.

Instruction in the mechanic arts was begun mainly through the efforts of President John D. Runkle, in 1876, when laboratories for instruction in chipping and filing and forging were established. In the following year, laboratories for instruction in carpentry, wood-turning, machine-tool work, and foundry work were added. These laboratories were the first established in this country to give instruction by the Russian method, which has the systematic instruction of the student as its aim, rather than construction.

Among the advantages to be derived from work in the mechanic arts may be mentioned the following:—

After having become familiar with the tools and appliances used, the student is able to judge what forms are easiest to construct and what processes are most economical of time and materials, and such knowledge is of great value in his future work in design.

The knowledge gained by actual work in the laboratories cannot be obtained by mere observation of the work of others. It is one thing to know how work should be done, and quite another to know how to do it. With such a foundation as the laboratory practice affords, it becomes an easy matter to obtain accurate information by the observation of processes or the work of others. One thus informed is enabled to judge what it is fair to ask of a mechanic as to quality and quantity of work and can if necessary show how faulty methods may be improved.

This work when properly carried on, developes the executive faculty, and leads to careful planning and clear thinking. Before starting on any work the student must, on consulting his drawing, make up his mind as to just what operations are to be performed and in what order, and then he proceeds to carry out his pre-arranged plan striving for good results and avoiding loss of time. For example, in the process of welding iron, he must carefully arrange his tools each in its proper place, ready at hand, for no time can be lost in this operation. He must properly arrange his fire to heat the pieces equally that they may reach the welding temperature at the same time, and finally when the proper heat is reached the work must be expeditiously done, without a false move to secure success. In forging the element of time always enters, it being necessary to work while the iron is hot; careful planning is necessary and the eye must be a guide as to shape and dimensions to a considerable extent. The order of operations is all important in machine work. Such training certainly begets habits of forethought and, judging from experience, is a more potent factor in this direction than ordinary laboratory practice.

The laboratories being conducted so far as practicable like model productive establishments, the student is made to be prompt in attendance, to keep tools and machines in order and clean, to keep a record of his time on each piece, and to conform to the rules of the laboratory, all of which tend to make him more systematic and to value his time as well as that of others. Where the students all work on the same or similar pieces, there is a spirit of friendly rivalry, which aids in stimulating the student to do his best and prepares him for similar conditions to be encounted later.

It is believed that the more training an engineer has in the mechanic arts, the more valuable will he be, and the better will he be able to successfully apply his theories.

Finally the man who understands how to execute work has confidence in himself, knows that the expected result will be obtained, and he thus begets the confidence of others. He is also more ready to appreciate the work of the skilled mechanic and is ready to learn from those who in general attainments may be far below him.